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In re Application of

Inventor: Christopher A. Schantz et al.

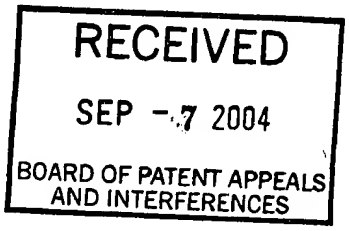
Title: ARRAY FABRICATION WITH DROP DETECTION

Serial No.: 09/558,532

Filed: April 26, 2000

Group Art Unit: 1634

Examiner: Betty J. Forman



Hon. Commissioner for Patents
Mail Stop Appeal Brief – Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

RESPONSE TO REQUEST FOR APPLICANTS TO ADDRESS MATTERS

This paper is submitted in response to the Board's Request for Applicants to Address Matters pursuant to 37 C.F.R. § 1.196 (d) and mailed on May 26, 2004.

Prior to addressing the issues raised in the outstanding Request, the Applicants respectfully request the Office to provide them with express acknowledgement that the Applicants' Reply Brief submitted May 12, 2003 is part of the file and is being considered by the Board. A copy of the submitted Reply Brief and the return receipt postcard were hand delivered to Doris Rogers of the Office on August 9, 2004. The Office is also requested to update PAIR to acknowledge receipt of the Reply Brief.

A. Matters Related to Drawings

The Board has request clarification regarding various matters related to the drawings, as specified in paragraphs A1 to A9. Each of these specific requests is now addressed separately below.

A1. With respect to element 18 appearing in Figure 4, this element was erroneously included on Figure 4 when the application was filed. As such, element 18 should not have been included in Figure 4. See the enclosed copy of Figure 4 showing this change. With respect to the request for a copy of the application as filed in electronic version, such is included with this response.

A2. With respect to element 170, this element should have been labeled as 214. See also Figure 7 which clearly shows sensor 214. See the enclosed copy of Figure 4 showing this change.

A3. With respect to element 14b appearing in Figure 4, this element was erroneously included on Figure 4 when the application was filed. As such, element 14b should not have been included in Figure 4. See the enclosed copy of Figure 4 showing this change.

A4. The element in Figure 5 which is beneath element 184 and between elements 160 and 324b should be labeled 186, and represents a reader/writer. See the enclosed copy of Figure 5 showing this change.

A5. Element 214h in Figure 6C should actually be element 214j. Furthermore, in the specification at page 15, line 3, the phrase "sensing element 214d" should actually read "sensing element 214j." See the enclosed copy of Figure 6C showing this change.

A6. The language "Opening 214" on page 14, line 25 should read "Opening 214b."

A7. Element 186 referred to in the specification is the element of Figure 5, as discussed in A4 above, which is a reader writer. Element 320 referred to in the specification actually refers to element 326 of Figure 4. As such, element 326 on Figure 4 should actually be element 320. See the enclosed copy of Figure 4 showing this change.

A8. As discussed in A2, element 170 of Figure 4 should actually be labeled 214. Element 214 on Figure 4 can take the alternative embodiments represented in Figures 6A to 6C. Element 214 is also shown in Figure 7.

A9. Element 190 of the specification should actually refer to element 324(b).

B. Documents Incorporated by Reference into the Specification

Enclosed please find full copies of the requested Caruthers, Itakura and Hunkapillar references. These references describe polynucleotide synthesis protocols summarized at Page 1, line 24 to Page 2, line 15 of the specification and are cited merely to provide further evidence that such protocols are known to those of skill in the art. The references each describe such protocols in detail and are relevant for this purpose in their entirety.

Enclosed please find full a full copy of the requested Southern reference. This reference describes bonding of polynucleotides to substrates in array production, as summarized at Page 1, line 24 to Page 2, line 15 of the specification, and is cited merely to provide further evidence that such protocols are known to those of skill in the art. The reference describes such protocols in detail and is relevant for this purpose in its entirety.

Application 09/150,507 has now issued as U.S. Patent No. 6,461,812. Of particular interest for purposes of the present application is the entire Detailed Description section and figures referenced therein.

Application 08/946,190 has now issued as U.S. Patent No. 6,086,190. Of particular interest for purposes of the present application is the entire Detailed Description section and figures referenced therein.

Enclosed please find a copy of application no. 09/359,527. Of particular interest for purposes of the present application is the entire Detailed Description section and figures referenced therein.

C. Reading Claims Onto the Drawings

4. A method of fabricating at least one addressable array [12] of biopolymers [p8, lines 21-32] with multiple features [16] on a substrate [10] using a drop deposition apparatus [Fig. 4] having a drop dispenser unit [210] and a sensing element [214 (170)], comprising:

(a) for each of multiple addresses [16], dispensing droplets [p13, lines 1-28] carrying the biopolymers [p8, lines 21-32] or biopolymer precursors [p8, line 32 to page 9, line 14] from a drop dispenser unit [210] onto the sensing element [214 (170)], and onto the substrate [10] so as to fabricate the array [12];

(b) detecting electrical signals [page 15, lines 16-21] resulting from dispensed droplets striking the sensing element [214 (170)];

(c) evaluating a performance characteristic [page 17, line 1 to page 18, line 7] of the deposition apparatus based on the detected signals [page 15, lines 16-21]

wherein the sensing element optionally comprises the substrate [10]; additionally comprising:

when after the dispensing of some droplets onto the substrate an error [page 19, line 10 to page 20, line 24] is detected [page 19, line 10 to page 20, line 24] in which an evaluated performance characteristic [page 17, line 1 to page 18, line 7] is outside a predetermined tolerance [page 19, lines 10 to 15], then the source [page 19, lines 16 to 17] of the error is corrected [page 19, lines 16 to 17] prior to dispensing [p13, lines 1-28] of other of the droplets [p13, lines 1-28] onto that same substrate [10] or the deposition apparatus is operated [page 19, lines 24-33] so as to compensate for the error [page 19, line 10 to page 20, line 24] during dispensing of other of the droplets [p13, lines 1-28] onto that same substrate [10].

5. A method according to claim 4 wherein the error [page 19, line 10 to page 20, line 24] is detected after the dispensing of some of the droplets for an array, and the source [page 19, lines 16 to 17]of the error is corrected [page 19, lines 16 to 17] prior to dispensing [p13, lines 1-28] of other of the droplets [p13, lines 1-28] for the same array [12] or the deposition apparatus is operated [page 19, lines 24-33] so as to compensate for the error [page 19, line 10 to page 20, line 24] during dispensing of other of the droplets [p13, lines 1-28] for the same array [12].

6. A method according to claim 4 wherein:

multiple arrays [12] are fabricated on the same substrate [10]; and

wherein the error is detected after the dispensing of droplets for at least one of the arrays on the same substrate, and the source [page 19, lines 16 to 17]of the error is [page 19, lines 16 to 17]corrected prior to dispensing [p13, lines 1-28] of droplets [p13, lines 1-28] for other of the arrays on the same substrate [10] or the deposition apparatus is operated [page 19, lines 24-33] so as to compensate for the error [page 19, line 10 to page 20, line 24] during dispensing of droplets [p13, lines 1-28] for the same array [12] or other of the arrays [12] on the same substrate [10].

7. A method of fabricating at least one addressable array [12] of biopolymers [p8, lines 21-32] with multiple features [16] on a substrate [10] using a drop deposition apparatus [Fig. 4] having a drop dispenser unit [210] and a sensing element [214 (170)], comprising:

(a) for each of multiple addresses [16], dispensing droplets [p13, lines 1-28] carrying the biopolymers [p8, lines 21-32] or biopolymer precursors [p8, line 32 to page 9, line 14] from a drop dispenser unit [210] onto the sensing element [214 (170)], and onto the substrate [10] so as to fabricate the array [12];

(b) detecting electrical signals [page 15, lines 16-21] resulting from dispensed droplets striking the sensing element [214 (170)];

(c) evaluating a performance characteristic [page 17, line 1 to page 18, line 7] of the deposition apparatus based on the detected signals [page 15, lines 16-21]

wherein the sensing element optionally comprises the substrate [10];

additionally comprising changing biopolymers or biopolymer precursors in the dispenser unit to different biopolymers or biopolymer precursors, wherein the detection and evaluation are performed after the changing and before a dispensing of any droplets for an array [page 18, lines 12-18].

9. A method according to claim 4 wherein the dispenser unit [210] comprises a pulse jet [p12, lines 20-33] which ejects a droplet in response to a signal [p12, line 30-

31] and which can de-prime [p 17, lines 11-12], and the error is corrected by re-priming the pulse jet [p19, lines 21-24].

10. A method of fabricating at least one addressable array [12] of biopolymers [p8, lines 21-32] with multiple features [16] on a substrate [10] using a drop deposition apparatus [Fig. 4] having a drop dispenser unit [210] and a sensing element [214 (170)], comprising:

(a) for each of multiple addresses [16], dispensing droplets [p13, lines 1-28] carrying the biopolymers [p8, lines 21-32] or biopolymer precursors [p8, line 32 to page 9, line 14] from a drop dispenser unit [210] onto the sensing element [214 (170)], and onto the substrate [10] so as to fabricate the array [12];

(b) detecting electrical signals [page 15, lines 16-21] resulting from dispensed droplets striking the sensing element [214 (170)];

(c) evaluating a performance characteristic [page 17, line 1 to page 18, line 7] of the deposition apparatus based on the detected signals [page 15, lines 16-21] wherein the sensing element optionally comprises the substrate [10];

additionally comprising when an error is detected in which an evaluated performance characteristic is outside a predetermined tolerance, identifying one or more features on the array which are defective as a result of the error [page 20, lines 8 to 15].

11. A method according to claim 10 additionally comprising communicating an identity of the identified defective features to a remote location [page 21, lines 14-16] or saving such information onto a storage medium [page 20, line 15].

13. A method of fabricating at least one addressable array [12] of biopolymers [p8, lines 21-32] with multiple features [16] on a substrate [10] using a drop deposition apparatus [Fig. 4] having a drop dispenser unit [210] and a sensing element [214 (170)], comprising:

(a) for each of multiple addresses [16], dispensing droplets [p13, lines 1-28] carrying the biopolymers [p8, lines 21-32] or biopolymer precursors [p8, line 32 to

page 9, line 14] from a drop dispenser unit [210] onto the sensing element [214 (170)], and onto the substrate [10] so as to fabricate the array [12];

(b) detecting electrical signals [page 15, lines 16-21] resulting from dispensed droplets striking the sensing element [214 (170)];

(c) evaluating a performance characteristic [page 17, line 1 to page 18, line 7] of the deposition apparatus based on the detected signals [page 15, lines 16-21]

wherein the sensing element optionally comprises the substrate [10];

and wherein:

the dispenser unit [210] comprises one or more pulse jets [p12, lines 20-33] which eject a droplet in response to a signal [p12, line 30-31] which require priming [page 17, line 7]; and

the evaluated performance characteristic is whether one or more of the pulse jets are primed prior to dispensing any droplets for an array [page 17, lines 9-12].

14. A method according to claim 13 additionally comprising, when an error is detected in which at least one of the pulse jets is not primed, then firing the pulse jet one or more times until the detected electrical signals indicate the pulse jet is primed [page 19, lines 21-24].

15. A method of fabricating at least one addressable array [12] of biopolymers [p8, lines 21-32] with multiple features [16] on a substrate [10] using a drop deposition apparatus [Fig. 4] having a drop dispenser unit [210] and a sensing element [214 (170)], comprising:

(a) for each of multiple addresses [16], dispensing droplets [p13, lines 1-28] carrying the biopolymers [p8, lines 21-32] or biopolymer precursors [p8, line 32 to page 9, line 14] from a drop dispenser unit [210] onto the sensing element [214 (170)], and onto the substrate [10] so as to fabricate the array [12];

(b) detecting electrical signals [page 15, lines 16-21] resulting from dispensed droplets striking the sensing element [214 (170)];

(c) evaluating a performance characteristic [page 17, line 1 to page 18, line 7] of the deposition apparatus based on the detected signals [page 15, lines 16-21]

wherein the sensing element optionally comprises the substrate [10];

and wherein:

the dispenser unit [210] is repeatedly scanned across the substrate [10] while dispensing droplets [p13, lines 1-28] so as to fabricate the array [12];

the sensing element [214] is struck by droplets so as to generate electrical signals [p13, lines 1-28] when the dispenser unit [210] passes beyond the array [12] being fabricated on multiple scans during fabrication of the array [12].

16. A method according to claim 15 wherein the sensing element [214] is struck by droplets so as to generate electrical signals [p13, lines 1-28] when the dispenser unit [210] passes beyond the array [12] being fabricated on each of multiple scans during fabrication of the array [12].

17. A method of fabricating at least one addressable array [12] of biopolymers [p8, lines 21-32] with multiple features [16] on a substrate [10] using a drop deposition apparatus [Fig. 4] having a drop dispenser unit [210] and a sensing element [214 (170)], comprising:

(a) for each of multiple addresses [16], dispensing droplets [p13, lines 1-28] carrying the biopolymers [p8, lines 21-32] or biopolymer precursors [p8, line 32 to page 9, line 14] from a drop dispenser unit [210] onto the sensing element [214 (170)], and onto the substrate [10] so as to fabricate the array [12];

(b) detecting electrical signals [page 15, lines 16-21] resulting from dispensed droplets striking the sensing element [214 (170)];

(c) evaluating a performance characteristic [page 17, line 1 to page 18, line 7] of the deposition apparatus based on the detected signals [page 15, lines 16-21]

wherein the sensing element optionally comprises the substrate [10];

and wherein the sensor [214] comprises the substrate [10].

21. A method of fabricating at least one addressable array [12] of biopolymers [p8, lines 21-32] with multiple features [16] on a substrate [10] using a drop deposition

apparatus [Fig. 4] having a drop dispenser unit [210] and a sensing element [214 (170)], comprising:

(a) for each of multiple addresses [16], dispensing droplets [p13, lines 1-28] carrying the biopolymers [p8, lines 21-32] or biopolymer precursors [p8, line 32 to page 9, line 14] from a drop dispenser unit [210] onto the sensing element [214 (170)], and onto the substrate [10] so as to fabricate the array [12];

(b) detecting electrical signals [page 15, lines 16-21] resulting from dispensed droplets striking the sensing element [214 (170)];

(c) evaluating a performance characteristic [page 17, line 1 to page 18, line 7] of the deposition apparatus based on the detected signals [page 15, lines 16-21]

wherein the sensing element optionally comprises the substrate [10];

and wherein the evaluated performance characteristic is the velocity of droplets [page 17, lines 14-16] dispensed from the drop dispenser unit [210];

the method additionally comprising dispensing multiple droplets from the dispenser unit [210] at each of at least two different distances from the sensor [214], and wherein droplet velocity is evaluated based on the phase difference between the detected signal from multiple droplets at each distance [page 17, lines 19-27].

28. An apparatus [FIG. 4] for fabricating at least one addressable array [12] of biopolymers on a substrate [10], comprising:

(a) a drop dispensing unit [210] which can deposit droplets carrying the biopolymers or biopolymer precursors onto different addresses [16] on the substrate [10] so as to fabricate the array [12];

(b) a sensing element [214] and amplifier [172] to detect electrical signals resulting from dispensed droplets striking the sensing element [214];

(c) a processor [140] which:

causes the drop dispensing unit [210] to dispense droplets toward the sensing element [214] after the dispensing of some droplets onto the substrate [10] and evaluates a performance characteristic of the dispensing unit based on the resulting detected signals; and

when an error is detected in which an evaluated performance characteristic is outside a predetermined tolerance then the processor, prior to causing the drop dispenser [21] to dispense droplets onto that same substrate [10], activates an operator alert or operates the apparatus so as to correct for the error before, or compensate for the error during, dispensing of other of the droplets onto that same substrate.

29. An apparatus according to claim 28 wherein:

the processor [140] causes the drop dispensing unit [210] to dispense droplets toward the sensing element [214] after dispensing of some droplets for an array [12]; and

when the error is detected the processor [140] activates the operator alert or operates the apparatus so as to correct for the error before, or compensate for the error during, dispensing of the other droplets for that same array.

30. An apparatus according to claim 28 wherein:

the processor [140] causes the drop dispensing unit [210] to dispense droplets so as to form multiple arrays [12] on the same substrate [10], and to dispense droplets toward the sensing element [214] after dispensing some of the droplets for the arrays [12] on the same substrate [10];

when the error is detected the processor [140] operates the apparatus so as to correct for the error before, or compensate for the error during, dispensing of the other droplets for other of the arrays [12] on the same substrate [10].

31. An apparatus [FIG. 4] for fabricating at least one addressable array [12] of biopolymers with multiple features [16] on a substrate [10], comprising:

(a) a drop dispensing unit [210] which can deposit droplets carrying the biopolymers or biopolymer precursors onto different addresses [16] on the substrate [10] so as to fabricate the array [12];

(b) a sensing element [214] and amplifier [172] to detect electrical signals resulting from dispensed droplets striking the sensing element [214];

(c) a processor [140] which:

causes the drop dispensing unit [210] to dispense droplets toward the sensing element [214] after the dispensing of some droplets onto the substrate [10] and evaluates a performance characteristic of the apparatus based on the resulting detected signals; and

when an error is detected in which an evaluated performance characteristic is outside a predetermined tolerance, identifies one or more features [16] on the array which are defective as a result of the error.

32. An apparatus according to claim 31 wherein the processor [140] additionally communicates an identity of the identified defective features to a remote location or saves such information onto a storage medium [324b].

38. An apparatus [FIG. 4] for fabricating at least one addressable array [12] of biopolymers on a substrate [10], comprising:

(a) a drop dispensing unit [210] which can deposit droplets carrying the biopolymers or biopolymer precursors onto different addresses [16] on the mounted substrate [20,10] so as to fabricate the array [12];

(b) a sensing element [214] and amplifier [172] to detect electrical signals resulting from dispensed droplets striking the sensing element [214];

(c) a processor [140] which causes the drop dispensing unit to dispense droplets toward the sensing element [214] and which evaluates a performance characteristic of the apparatus based on the resulting detected signals, wherein the evaluated performance characteristic is the velocity or placement of droplets;

wherein the processor causes the dispenser unit [210] to dispense multiple droplets at each of at least two different distances from the sensor [214], and wherein droplet velocity is evaluated based on the phase difference between the detected signal from multiple droplets at each distance.

43. A computer program product [page 7, lines 19-26] comprising a computer readable storage medium carrying computer readable program code, for use with an apparatus [FIG. 4] for fabricating an array [12] of features [16] which apparatus

includes a drop deposition unit [210] and a sensing element [214], the program code when loaded into the computer performing the steps of:

(a) for each of multiple addresses [16], dispensing droplets carrying the biopolymers or biopolymer precursors from a drop dispensing unit [210] onto the substrate [10], so as to fabricate the array;

(b) detecting electrical signals resulting from dispensed droplets striking a sensing element [214] during step (a);

(c) evaluating a performance characteristic of the apparatus based on the detected signals; and

(d) when an error is detected in which an evaluated performance characteristic is outside a predetermined tolerance then, prior to causing the drop dispenser [210] to dispense droplets onto that same substrate [10], activating an operator alert or operating the apparatus so as to correct for the error before, or compensate for the error during, dispensing of other of the droplets onto that same substrate [10].

44. A computer program product [page 7, lines 19-26] comprising a computer readable storage medium carrying computer readable program code, for use with an apparatus [FIG. 4] for fabricating an array [12] of features 16] which apparatus includes a drop deposition unit [210] and a sensing element [214], the program code when loaded into the computer performing the steps of:

(a) for each of multiple addresses [16], dispensing droplets carrying the biopolymers or biopolymer precursors from a drop dispensing unit [214] onto the substrate [10], so as to fabricate the array [12];

(b) dispensing droplets toward the sensing element [214] after the dispensing of some droplets onto the substrate [10];

(b) detecting electrical signals resulting from dispensed droplets striking a sensing element [214] during step (b);

(c) evaluating a performance characteristic of the apparatus based on the detected signals; and

(d) when an error is detected in which an evaluated performance characteristic is outside a predetermined tolerance, identifying one or more features [16] on the array which are defective as a result of the error.

CONCLUSION

It is believed that this communication provides a complete response to the Board's request.

In view of the prior filed Appeal Brief and Reply Brief, all of the rejections of claims 4-7, 9-11, 13-17, 21, 28-32, 38, 43, 44 should be reversed.

Respectfully submitted,

Bret Field
Registration No. 37,620

encs:

- Copies of Caruthers et al., Itakura et al., Hunkapillar et al., Southern et al., and 09/359,527
- Electronic Version of Application as Filed
- Copies of Figures 4, 5 and 6 showing changes